PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Commissioner
US Department of Commerce
United States Patent and Trademark
Office, PCT
2011 South Clark Place Room
CP2/5C24
Arlington, VA 22202
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 16 November 2000 (16.11.00)	
International application No. PCT/GB00/00959	**Applicant's or agent's file reference** MJD/51924001
International filing date (day/month/year) 15 March 2000 (15.03.00)	**Priority date** (day/month/year) 16 March 1999 (16.03.99)
Applicant BRIDGES, Robert	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

16 October 2000 (16.10.00)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer Olivia TEFY
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

The International Preliminary Examining Authority
EUROPEAN PATENT OFFICE,
Erhardtstrasse 27,
D-80331 MUNICH,
GERMANY.

BY FAX TO: 00 49 89 2399 4465
FROM: 020 7430 7600 - 8 PAGES
CONFIRMATION BY POST

16 October 2000

Dear Sirs,

European Patent Application No. PCT/GB00/00959
Masstech International Limited
Representative's Ref: MJD/51924/001

We are filing herewith the Chapter II Demand for the above mentioned application. We are also filing herewith with the fax copy of this letter only Debit Order No. 16929 in respect of the handling fee and preliminary examination fee.

As the basis for International Preliminary Examination, we are filing herewith amended page 13 to which new claim 29 has been added. We ask that the following comments be taken into account during International Preliminary Examination.

Claim 29 is directed to a method of detecting leaks from a vessel in a filling station. Basis for this can be found in the description of the fourth example as referred to from lines 7 to 36 of page 8 and shown in Figs. 4, 4A and 5. Also, the first two paragraphs on page 1 indicate that the invention is applicable to

filling stations to detect the presence of unwanted chemicals. In the context of filling stations, such contaminants will only come from leakage. It is therefore submitted that new claim 29 has fair basis in the application as filed.

Yours faithfully,

DRAPER, Martyn John

Enc.

: 213004: MJD: VAM: FURNDOCS

24. A device according to claim 23, wherein the failure element and indicator element are arranged to be supported vertically, wherein the further force is gravity.

25. A device according to any one of claims 13 to 24, wherein the length of the failure element in the direction in which the indicator element moves on failure is at least 3 times, preferably at least 10 times, more preferably at least 20 times, and most preferably at least 50 times its size in any other dimension.

26. A device according to any one of claims 13 to 25, wherein the failure element comprises a number of different materials arranged in series and/or in parallel.

27. An arrangement for detecting the presence of a chemical contaminant over a predetermined area, the arrangement comprising a plurality of devices according to any one of the preceding claims arranged over the area.

28. An arrangement according to claim 27, wherein the devices are arranged substantially in parallel.

29. A method of detecting leaks from a vessel in a filling station containing a potential source of chemical contaminants, the method comprising the steps of positioning a device according to any one of claims 1 to 26 or an arrangement according to claim 27 or claim 28 in the ground beneath a vessel; and

monitoring the or each failure element to determine when it has moved to a second position indicating the presence of a leak.

EUROPEAN PATENT OFFICE,
Erhardtstrasse 27,
D-80331 MUNICH,
GERMANY.

For the Attention of the International Preliminary Examining Authority

24 January 2001

Dear Sirs,

International Patent Application No. PCT/GB00/00959
Masstech International Limited
Representative's Ref: MJD/51924/001

In response to the Written Opinion of 12 December 2000, we are filing herewith in triplicate amended page 9 to replace the existing page 9.

The words *"to be detected"* on line 8 of page 9 have been changed to *"contaminant"* in order to clarify claim 1 and distinguish more clearly from D1.

In essence, the fundamental distinction between the present invention and D1 is that D1 is not a device for detecting the presence of a chemical contaminant. Indeed, the device of D1 is totally unsuitable for detecting the presence of a chemical contaminant and there is nothing in D1 which suggests that it could be used in such a way.

D1 relates to the detection of corrosion within a structural element. It does this by providing a failure element which is made of a material which is the same as the material of the piping. In other words, the failure element is designed to be resistant to the chemical which attacks it. The failure element is designed to fail, if at all, in an extremely slow way by process of an aggregated, continuous, progressive attack. The device of D1 is intended as an early warning indicator to provide an indication of impending structural failure.

By contrast, the present invention is designed to be in contact with one medium, such as ground water or air, and only to trigger in the presence of an abnormal chemical. In other words, the device for the present invention is designed to be external to the system being monitored. The failure element of the present invention must fail quickly if it is to be successful in detecting the presence of a leak.

The device of D1 would be totally unsuitable for detecting the presence of the chemical contaminant. The time taken for D1 to fail is many orders of magnitude greater than the time scale envisaged for the successful detection of a chemical leak. Further, it cannot be considered obvious to adapt D1 so that it is suitable for detecting the presence of a chemical contaminant as there is no motivation in D1 for doing so. If the device in D1 were to be adapted in this way, it would then simply not function in its intended way to provide a detection of corrosion. D1 simply relates to an entirely different field from the present invention and there is no reason why the skilled person would be motivated to apply this device in the unrelated field of leak detection.

Similar arguments apply to method claim 29 which the examiner has objected as lacking an inventive step in view of D1 and D4. As with D1, D4 also does not relate to a method of detecting leakage. Instead, it is limited to detection and prevention of stress corrosion cracking. It does this in an entirely different way from the tensioned failure element of the present invention. Instead, it detects the presence of cracking by monitoring the changes of electrical resistence of *"test coupons"*. The examiner has stated that he is justified in combining D4 with D1 as D1 is referred to in D4. However, this cross-reference is only in the context of acknowledging prior art. The invention of D4 is presented as an improvement of the device of D1 for detecting stress corrosion cracking and it is therefore implied from D4 that the substitution of the device of D1 into D4 would, in fact, be a retrograde step that D4 is steering the reader away from. In any case, even if it were obvious to combine D1 and D4, as both relate to the detection of stress corrosion cracking, neither can be relevant to a claim directed to a method of detecting leaks. In order to detect stress corrosion cracking, the sacrificial element must be exposed to the normal working liquid. Such an element would be useless in the detection of leakage for the reasons given above.

We submit that claims 1 and 29 are now both novel and inventive over all of the available prior art and we look forward to receiving the International Preliminary Examination Report in due course.

Yours faithfully,

DRAPER; Martyn John
Representative for the Applicant

Encs.

: 269020: MJD: VAM: LONDOCS

CLAIMS:

1. A device for detecting the presence of a chemical contaminant, the device comprising an indicator element which is held in a first position by means of a failure element which is held in tension, the failure element being made of a material which fails in the presence of the chemical contaminant, thereby releasing the indicator element from its first position and allowing it to move into a second position in order to provide an indication of the presence of the contaminant.

2. A device according to claim 1, wherein the indicator element is held in the first position by a biasing force, the biasing force acting to move the indicator element to the second position upon failure of the failure element.

3. A device according to claim 2, wherein the biasing force is provided by the resilience of the indicator element.

4. A device according to claim 3, wherein the resilient indicator element is a spring which is fixed to the failure element, the spring being under compression, such that the failure element is under tension.

5. A device according to any preceding claim, wherein the failure element is a tubular member.

6. A device according to claim 5, wherein the tubular member is sealed, the inside of the tubular member is maintained at a pressure other than atmospheric, and means are provided to monitor this pressure to determine the integrity of the tubular

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PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
MJD/51924001		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/GB00/00959	15/03/2000	16/03/1999
International Patent Classification (IPC) or national classification and IPC G01N17/00		
Applicant MASSTECH INTERNATIONAL LIMITED et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 7 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 2 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
16/10/2000	08.06.2001
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Mason, W Telephone No. +49 89 2399 2623

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB00/00959

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:
Description, pages:

1-8	as originally filed			

Claims, No.:

2-28	as originally filed			
29	as received on	17/10/2000	with letter of	16/10/2000
1	as received on	25/01/2001	with letter of	24/01/2001

Drawings, sheets:

1/3-3/3	as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   - ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
   - ☐ the language of publication of the international application (under Rule 48.3(b)).
   - ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   - ☐ contained in the international application in written form.
   - ☐ filed together with the international application in computer readable form.
   - ☐ furnished subsequently to this Authority in written form.
   - ☐ furnished subsequently to this Authority in computer readable form.
   - ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
   - ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

   ☐ the description, pages:
   ☐ the claims, Nos.:
   ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	
	No:	Claims	1-4,9,11,13-17,22-25
Inventive step (IS)	Yes:	Claims	
	No:	Claims	5-8,10,12,18-21,26-29
Industrial applicability (IA)	Yes:	Claims	1-29
	No:	Claims	

2. Citations and explanations
   see separate sheet

GENERAL

The present application concerns a device (claims 1, 13) for detecting the presence of a chemical contaminant by means of its effect on an indicator element held under tension (by a spring) which is liable to failure in the presence of said contaminant causing movement of an indicator element from a first position to a second position. Also claimed (claims 27-28) is an arrangement and a method (claim 29) for detecting the presence of a chemical contaminant over a predetermined area comprising a plurality of devices according to preceding claims.

The following documents are referred to in this opinion:

D1=US3846795; D2=WO8801052; D3=US4628252; D4=US5728943
D5=US4271120

The following amendments do not go beyond the disclosure of the international application as filed for the reasons indicated:

Claim 29 - introduced after filing.
Page 1, lines 5-10; page 6, lines 5-10; page 8., lines 5-20; claim 27; Fig. 4.

Claim 1 - amended.
Page 5, lines 5-20; page 6, lines 20-25.

SECTION V

1. D1 (Fig. 1) is considered to represent the closest prior art and discloses, "Apparatus for providing an early warning of impending failure of a system structural element subject to corrosion. The apparatus provides a housing containing a corrodible member and coupled to the structure so as to expose the corrodible member to the same corrosive environment as in the system." With reference to Fig. 1 " When the specimen 30 cracks and fails, the spring 26 drives upper support 28 upward, carrying with it the magnetic member 37. In accordance

with the invention, movement of the magnetic member is sensed."

2. CLAIMS 1-26; NOVELTY AND INVENTIVE STEP

D1 (Fig. 1; cols 3-4) is considered to represent the closest prior art and to disclose all physical features of the devices according to claims 1-4, 9, 11, 13-17,22-25.

In addition to the above, the device of D1 is also suitable for use in detecting the presence of a chemical contaminant. This is apparent from: col 1, lines 25-30; col 2, line 66 - col 3, line 5; col 5, lines 50-55 which disclose that the corrosive activity is due to impurities in the pure cooling water (i.e. contaminants) such as high salt content, reactive halogens and halides, MgCl2, NaCl and that the system is for use in the chemical industry where corrosive fluids are present. D1, col 6, lines 53-67 goes even further disclosing explicitly that the shortened lifetime of a corrodible member can be attributed to the presence of a contaminant e.g. chlorine.

Claims 1-4, 9, 11, 13-17,22-25 therefore do not meet the requirement of novelty (Art. 33.2 PCT).

The following features are not disclosed in D1 but are disclosed in or are evident from the prior art as indicated:

a) Claim 5, 10, 18. The failure element is a TUBULAR member. The device of D1 is for determining defects in piping in nuclear reactors but the samples used are in the form of a piece of such pipe. Corrosion monitoring probes using tubular elements are however well known in the art - see e.g D2.

b) Claims 6, 19. The tubular member is sealed under pressure. Both D1 and D4 discuss the use of measuring apparatus on samples in the form of pipelines used for transporting fluids under pressure to avoid leaks. It would therefore be obvious to the skilled person to ensure that the sample is subjected to conditions equivalent to those experienced in practice by maintaining pressure inside a tubular sample.

c) Claim 7, 20. The use of a "starlock" washer for anchoring spring to element. In D1 the spring is anchored to the failure element by means of a threaded nut and bolt arrangement - the use of washer of any type is considered to be an obvious choice from a limited number of alternative mechanical anchoring arrangements.

d) Claim 8, 21. The failure element changes its appearance in the presence of contaminant. D1 (col 1, lines 35-45) discusses the effects of certain contaminants on elements in the form of metal pipings used in nuclear reactor field which cause pitting of the surface.

e) Claim 12, 26. The failure element is a number of materials arranged in series or parallel - D3 (Fig. 1) discloses a parallel arrangement of elements subjected to corrosion - the use of a plurality of elements in a serial arrangement is a complementary alternative.

Claims 5-8,10, 12, 18-21, 26 therefore do not meet the requirement of inventive step (Art. 33.3 PCT).

3. CLAIMS 27-28; NOVELTY AND INVENTIVE STEP

Claims 27-28. D4 (Fig. 1) discloses pipeline corrosion testing in which test samples in the form of a plurality of coupons of pre-stressed pipeline portions are buried - this document in its discussion of prior art makes direct reference to D1.

D4 relates generally to the field of detection of stress corrosion cracking (SCC) and discusses in reference to the prior art (D4, cols 1-2) several techniques which are used there. D4 specifically is concerned with the use of, "an SCC sensor including multiple coupons place in the same environment as the structure of interest" (col 3, lines 1-2). Only two of the prior art documents referred to in D4 also concern such a technique - D1 and US 5307385 - which are introduced by the wording, " It is also possible to measure the mechanical properties of **samples exposed to the same conditions as an item of interest".**

The replacement of the coupons of D4 by the items i.e. "corrodible members" of D1 in view of this cross reference would therefore be straightforward so that a

combination of the sample testing items of the form in D1 and the arrangement of buried parallel samples over an predetermined area would be obvious.

Claims 27-28 therefore do not meet the requirement of inventive step (Art. 33. 3 PCT).

4. CLAIM 29; NOVELTY AND INVENTIVE STEP

Claim 29 relates to a method of detecting leaks from a vessel in a filling sation by positioning a device according to claims 1-28 in the ground beneath the vessel and monitoring the failure of the elements to indicate the presence of a leak.

Although D4 (Figs. 1, 12, 19) discloses in its embodiments positioning the device comprising the plurality of coupons adjacent to a PIPELINE structure, this is not the only structure to which the disclosure is relevant as indicated in col 2, lines 65-67 - other possible structures in this field of application are suggested in col 1, lines 58-64 and include "pipelines, tubing, STORAGE TANKS, tanker cargo oil pipes...". D4 is entitled "Method and System for detection and prevention of stress corrosion cracking in BURIED STRUCTURES" with respect to storage tank structures this would imply location of the testing device adjacent the buried portion either laterally or underneath.

Claim 29 therefore does not meet the requirement of inventive step (Art. 33.3 PCT) in view of D4 as closest prior art and the cross reference to D1.

CLAIMS:

1. A device for detecting the presence of a chemical contaminant, the device comprising an indicator element which is held in a first position by means of a failure element which is held in tension, the failure element being made of a material which fails in the presence of the chemical to be detected, thereby releasing the indicator element from its first position and allowing it to move into a second position in order to provide an indication of the presence of the contaminant.

2. A device according to claim 1, wherein the indicator element is held in the first position by a biasing force, the biasing force acting to move the indicator element to the second position upon failure of the failure element.

3. A device according to claim 2, wherein the biasing force is provided by the resilience of the indicator element.

4. A device according to claim 3, wherein the resilient indicator element is a spring which is fixed to the failure element, the spring being under compression, such that the failure element is under tension.

5. A device according to any preceding claim, wherein the failure element is a tubular member.

6. A device according to claim 5, wherein the tubular member is sealed, the inside of the tubular member is maintained at a pressure other than atmospheric, and means are provided to monitor this pressure to determine the integrity of the tubular

24. A device according to claim 23, wherein the failure element and indicator element are arranged to be supported vertically, wherein the further force is gravity.

25. A device according to any one of claims 13 to 24, wherein the length of the failure element in the direction in which the indicator element moves on failure is at least 3 times, preferably at least 10 times, more preferably at least 20 times, and most preferably at least 50 times its size in any other dimension.

26. A device according to any one of claims 13 to 25, wherein the failure element comprises a number of different materials arranged in series and/or in parallel.

27. An arrangement for detecting the presence of a chemical contaminant over a predetermined area, the arrangement comprising a plurality of devices according to any one of the preceding claims arranged over the area.

28. An arrangement according to claim 27, wherein the devices are arranged substantially in parallel.

PATENT COOPERATION TREATY

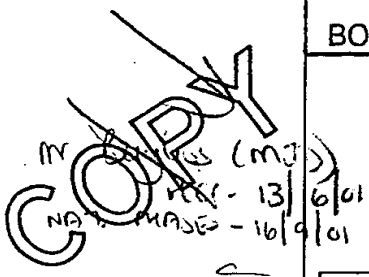
RECEIVED
13 JUN 2001
BOULT WADE TENNANT

PCT

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

BOULT WADE TENNANT
VERULAM GARDENS
70 Gray's Inn Road
London WC1X8BT
GRANDE BRETAGNE



NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT
(PCT Rule 71.1)

Date of mailing *(day/month/year)*	08.06.2001
Applicant's or agent's file reference MJD/51924001	**IMPORTANT NOTIFICATION**

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/GB00/00959	15/03/2000	16/03/1999

Applicant
MASSTECH INTERNATIONAL LIMITED et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. **REMINDER**

   The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

   Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

   For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/	Authorized officer
European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Conner, M Tel.+49 89 2399-2241

Form PCT/IPEA/416 (July 1992)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	**FOR FURTHER ACTION** see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
MJD/51924001		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/GB 00/ 00959	15/03/2000	16/03/1999
Applicant		
MASSTECH INTERNATIONAL LIMITED et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

[ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

[ ] contained in the international application in written form.

[ ] filed together with the international application in computer readable form.

[ ] furnished subsequently to this Authority in written form.

[ ] furnished subsequently to this Authority in computer readble form.

[ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

[ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

[X] the text is approved as submitted by the applicant.

[ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

[X] the text is approved as submitted by the applicant.

[ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 1

[ ] as suggested by the applicant.

[X] because the applicant failed to suggest a figure.

[ ] because this figure better characterizes the invention.

[ ] None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 00/00959

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G01N17/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 846 795 A (JONES C) 5 November 1974 (1974-11-05) column 3 -column 4; figure 1	1-28
A	WO 88 01052 A (UNIV MANCHESTER) 11 February 1988 (1988-02-11) figure 1	1-28
A	US 4 628 252 A (TERHUNE JAMES H ET AL) 9 December 1986 (1986-12-09) figure 1	1-28
A	US 5 728 943 A (RIZZO FRANK E ET AL) 17 March 1998 (1998-03-17) figures 1,2	1-28

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 May 2000	30/05/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Mason, W

1

Form PCT/ISA/210 (second sheet) (July 1992)

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 271 120 A (MICHAUD LOUIS M) 2 June 1981 (1981-06-02) figure 1	1-28
A	FR 2 704 318 A (RENAULT VEHICULES IND) 28 October 1994 (1994-10-28) figure 1	1-28
A	PATENT ABSTRACTS OF JAPAN vol. 006, no. 148 (P-133), 7 August 1982 (1982-08-07) & JP 57 067843 A (TOKYO KOKI SEIZOSHO:KK), 24 April 1982 (1982-04-24) abstract	1-28
A	US 4 335 615 A (KALFA HORST ET AL) 22 June 1982 (1982-06-22) figure 1	1-28
A	US 4 237 972 A (LANMON C P II) 9 December 1980 (1980-12-09) figures 3,4	1-28

1

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Information on patent family members

International Application No
PCT/GB 00/00959

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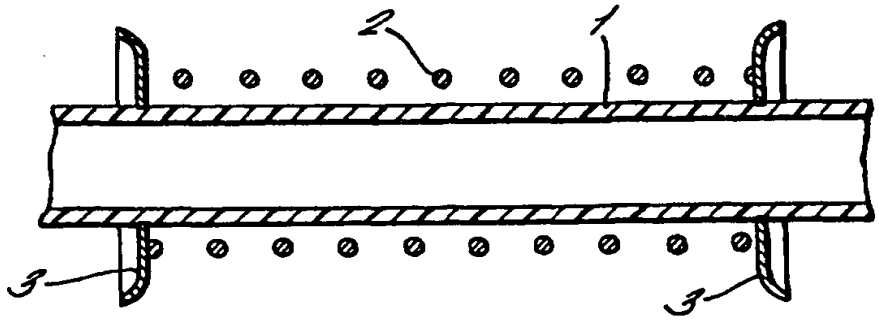
(54) Title: A DEVICE FOR DETECTING THE PRESENCE OF A CHEMICAL CONTAMINANT

(57) Abstract

The disclosure relates to a device for detecting the presence of a chemical contaminant. The device comprising a resilient indicator element (2, 6) which is biased into a first position and is anchored in the first position by means of a failure element (1, 5). The failure element is made of a material which fails in the presence of a chemical to be detected, thereby releasing the indicator element from its first position and allowing it to move under its own resilience into a second position in order to provide an indication of the presence of the contaminant.



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A DEVICE FOR DETECTING THE PRESENCE OF A CHEMICAL CONTAMINANT

The present invention relates to a device such as an indicator, switch or actuator for detecting the presence of a chemical contaminant. Such a detector is used, for example, in filling stations and chemical plants to detect the presence of unwanted chemicals.

Chemical detection devices are frequently electronic and therefore have to be designed to be intrinsically safe making them prohibitively expensive for many applications and are dependent on the reliability of the power supply. Further, recent surveys in filling stations have shown that many of these devices have been physically disabled or no longer function for other reasons.

The present invention aims to provide a low cost, disposable device which does not require electricity.

According to a first aspect of the present invention there is provided a device for detecting the presence of a chemical contaminant, the device comprising an indicator element which is held in a first position by means of a failure element which is held in tension, the failure element being made of a material which fails in the presence of the chemical to be detected, thereby releasing the indicator element from its first position and allowing it to move into a second position in order to provide an indication of the presence of the contaminant.

According to a second aspect of the present invention, which may be independent of, or used in

conjunction with the first aspect of the invention, there is provided a device for detecting the presence of a chemical contaminant, the device comprising a resilient indicator element which is held in a first position and is anchored in the first position by means of a failure element, the failure element being made of a material which fails in the presence of the chemical to be detected, thereby releasing the indicator element from its first position and allowing it to move into a second position in order to provide an indication of the presence of the contaminant; wherein the failure element is elongate in the sense that it is larger in the direction in which the indicator element moves on failure of the failure element than it is in any other dimension.

The device is based on simple chemistry and therefore cannot fail to work upon contact with the chemical to be detected. The device can be made very simple in construction allowing it to be produced very cheaply.

At present, when monitoring wells, it is necessary to take a sample from every well to determine whether or not contamination has occurred. With the present invention it would only be necessary to take samples from wells where the element has failed.

With the first aspect of the invention, as the failure element is held in tension, a failure, no matter how small, anywhere along the failure element, will cause the device to indicate the presence of a contaminant.

With the second aspect of the invention, as the failure element is elongate (for example, the length

of the failure element in the direction in which the indicator element moves on failure is at least 3 times, preferably at least 10 times, more preferably at least 20 times, and most preferably at least 50 times its size in any other dimension), it can be extended across a zone in which chemical contaminant is to be detected, thereby providing a cost effective way of detection beyond a single location.

The indicator element may be held in the first position by a biasing force, the biasing force acting to move the indicator element to the second position upon failure of the failure element. Alternatively, the indicator element is held in the first position by a biasing force and wherein a further force, which is strong enough to override the biasing force is arranged to act on the indicator element to move it to the second position upon failure of the failure element.

In its simplest form the indicator element is a spring which is fixed to the failure element, the spring being under compression, such that the failure element is under tension. The failure element is preferably a tubular member. In order to provide a further degree of monitoring of the condition of the failure element, the tubular member is preferably sealed, the inside of the tubular member is maintained at a pressure other than atmospheric, and means are provided to monitor this pressure to determine the integrity of the tubular member. In order to operate a valve, a cable can pass through the tubular member and be fixed to one end of the spring such that, on failure of the failure element the cable is pulled through the tubular member to operate the valve. The spring is preferably attached to the failure element by a respective washer at each end of the spring, each

washer being anchored to the failure element so as to be capable of movement in only one direction along the failure element. This allows the indicator element to be fastened in place with the necessary preload by pushing each washer along the failure element. The washer will then be held in place as the spring will tend to urge it in the direction in which it cannot move.

In order to assist with an assessment of the full extent of a chemical contaminant, the failure element is preferably made of a material which changes its appearance in the present of the contaminant.

Preferably, the failure element is a tubular element and the indicator element is within the tubular element and is fixed at one end to the failure element, while its other end projects beyond the other end of the failure element and is biased away from the other end of the failure element.

The further force may be any type of force, such as a magnetic force. However, preferably, the failure element and indicator element are arranged to be supported vertically, wherein the further force is gravity.

In an alternative arrangement the indicator element comprises a core surrounded by a sleeve, the sleeve being biased away from the core, wherein the failure element holds the sleeve in a position in which it surrounds the core, whereby, when the failure element fails, the sleeve is released and moved away from the core providing a visual indication of the presence of the contaminant. Preferably, the outer surface of the sleeve is a different colour from the outer surface of the core, thereby improving the

visual indication of the presence of a contaminant.

In addition to the provision of visual indication, the device can also be arranged to operate some failsafe mechanism to prevent further contamination, such as by automatically closing a valve.

In its simplest form, the failure element is made of a single material which fails in the presence of a single contaminant. However, more complex devices are envisaged where the failure element comprises a number of different materials arranged in series and/or in parallel. With different materials arranged in series, the device will operate when any one of a number of contaminants to which a single material is responsive, is present. A parallel arrangement, on the other hand, will only fail when contaminants to which all of the materials are responsive are present. With a combination of series and parallel materials, a device can be tailored to detect a sophisticated selection of contaminants.

In order to detect the presence of a contaminant, several of the devices described above are arranged over the area, preferably in parallel. This allow a map of the location and extent of a contaminant to be created.

Examples of devices constructed in accordance with the present invention will now be described with reference to the accompanying drawings, in which:

Fig. 1 is a schematic cross-section of a first example;

Fig. 2 is a cross-section of a second example;

Fig. 3 is a cross-section of a ground water monitoring well having a device according to the present invention;

Fig. 4 shows a device according to the present invention positioned under a tank in order to monitor leakage from the tank;

Fig. 4A is a detail of the part ringed as 4A in Fig. 4; and

Fig. 5 is a schematic plan view showing the operation of Fig. 4 to determine the full extent of contaminant leakage.

The device shown in Fig 1 comprises a tubular member 1 of high-density polystyrene. Attached to the tubular member 1 is a spring 2 which is held in compression by a pair of starlock washers 3 which anchor it to the tubular member 1. In the presence of a chemical contaminant, in this case any petroleum product, the tubular member 1 will fail and the spring 2 extends. The extension of the spring can be used to trigger a mechanical signal or alarm, or can close valves. A cable, such as a bowden cable, may extend through the tubular element and be fixed to one end of the starlock washers. On failure of the tubular member, the cable will be pulled through the tubular element allowing operation of a valve. The failure made may be shearing, stretching or bending of the tubular member, but is more likely to be slippage of a starlock washer when the surface of the tubular member has been degraded by the contaminant.

A second example is shown in Fig 2. In this case, the device is built around a central rod 4 on

which are threaded three failure elements 5 of expanded polystyrene, and a resilient indicator element 6. The failure elements 5 and resilient indicator element 6 are held in place by a pair of starlock washers 7. The resilient indicator element 6 comprises a sleeve 8 surrounding a core 9. The sleeve 8 and core 9 are biased away from one another by compression spring 10. When any one of the failure elements 5 fails in the presence of a chemical contaminant, the compression of spring 10 forces the sleeve 8 and core 9 axially away from one another, so that the outer surface of the core 9 is uncovered providing a visual indication that failure has occurred.

A third example is shown in Fig. 3. This shows a device used in a ground water monitoring well which is buried below ground level 11. The well comprises a slotted or perforated well casing 12 closed at its top end by a well monitoring cap 13. In this case, the failure element 14 is a tubular member which is suspended from the cap 13 and fixed at its bottom end to a weight 15. The indicator element comprises an elongate rod 16 extending within the failure element 14 and attached at its lower end to the weight 15, and a spring 17 mounted in the cap 13 and acting to bias the rod 16 upwardly.

The lower part of the well is filled with ground water 18. If a chemical contaminant 19 is present floating on the ground water 18, this will react chemically with the failure member 14 causing it to fail. At this time, the full mass of the weight 15 is held by the rod 16 which will be pulled downwardly under gravity compressing spring 17 and providing a visual indication at the well cap of the presence of the contaminant.

When monitoring a well, the device could be several metres long, so that no matter at what level the hydrocarbon contaminant existed, the element would fail.

A fourth example is shown in Figs. 4, 4A and 5. This example is designed to detect leakage from a tank 20. A plurality of elongate devices are buried in the ground 21 beneath the tank 20. Fig. 4 shows one such indicator, and the arrangement of all of the indicators is shown in plan in Fig. 5. The device comprises a perforated tube 22 containing elongate failure element 23 which projects from one end of the perforated tube 22 and is fastened at the other end of the tube 22. A spring 24 providing the indicator element is provided to bias a starlock washer 25 attached to the end of the failure element 23 away from a washer 26 at the end of the perforated tube 22 hence holding the failure element in tension.

When a chemical contaminant 27 leaks from the tank 20, it will enter the perforated tubes 22 immediately below the leak and will cause certain failure elements 23 to fail. Once a failure element 23 fails at any location, the spring 24 which is held in compression, will push the starlock washer 25 away from the end of the tube 22 thereby providing a visual indication of the presence of a contaminant. Once a contaminant is detected, all of the failure elements 23 can be pulled out and inspected. If they are made of a material which changes its appearance or is entirely obliterated in the presence of the contaminant, it is possible to build up a map showing the location and extent of the contaminant 27 as shown in Fig. 5.

CLAIMS:

1. A device for detecting the presence of a chemical contaminant, the device comprising an indicator element which is held in a first position by means of a failure element which is held in tension, the failure element being made of a material which fails in the presence of the chemical to be detected, thereby releasing the indicator element from its first position and allowing it to move into a second position in order to provide an indication of the presence of the contaminant.

2. A device according to claim 1, wherein the indicator element is held in the first position by a biasing force, the biasing force acting to move the indicator element to the second position upon failure of the failure element.

3. A device according to claim 2, wherein the biasing force is provided by the resilience of the indicator element.

4. A device according to claim 3, wherein the resilient indicator element is a spring which is fixed to the failure element, the spring being under compression, such that the failure element is under tension.

5. A device according to any preceding claim, wherein the failure element is a tubular member.

6. A device according to claim 5, wherein the tubular member is sealed, the inside of the tubular member is maintained at a pressure other than atmospheric, and means are provided to monitor this pressure to determine the integrity of the tubular

member.

7. A device according to any one of claims 4 to 6, wherein the spring is attached to the failure element by a respective starlock washer at each end of the spring each washer being anchored to the failure element so as to be capable of movement in only one direction along the failure element.

8. A device according to any one of the preceding claims, wherein the failure element is made of a material which changes its appearance in the presence of the contaminant.

9. A device according to claim 1, wherein the indicator element is held in the first position by a biasing force and wherein a further force, which is strong enough to override the biasing force is arranged to act on the indicator element to move it to the second position upon failure of the failure element.

10. A device according to claim 9, wherein the failure element is a tubular element and the indicator element is within the tubular element and is fixed at one end to the failure element, while its other end projects beyond the other end of the failure element and is biased away from the other end of the failure element.

11. A device according to claim 9, wherein the failure element and indicator element are arranged to be supported vertically, wherein the further force is gravity.

12. A device according to any one of the preceding claims, wherein the failure element comprises a number

of different materials arranged in series and/or in parallel.

13. A device for detecting the presence of a chemical contaminant, the device comprising a resilient indicator element which is held in a first position and is anchored in the first position by means of a failure element, the failure element being made of a material which fails in the presence of the chemical to be detected, thereby releasing the indicator element from its first position and allowing it to move into a second position in order to provide an indication of the presence of the contaminant; wherein the failure element is elongate in the sense that it is larger in the direction in which the indicator element moves on failure of the failure element than it is in any other dimension.

14. A device according to claim 13, wherein the failure element is held in tension.

15. A device according to claim 13 or claim 14, wherein the indicator element is held in the first position by a biasing force, the biasing force acting to move the indicator element to the second position upon failure of the failure element.

16. A device according to claim 15, wherein the biasing force is provided by the resilience of the indicator element.

17. A device according to claim 16, wherein the resilient indicator element is a spring which is fixed to the failure element, the spring being under compression, such that the failure element is under tension.

18. A device according to any one of claims 13 to 17, wherein the failure element is a tubular member.

19. A device according to claim 18, wherein the tubular member is sealed, the inside of the tubular member is maintained at a pressure other than atmospheric, and means are provided to monitor this pressure to determine the integrity of the tubular member.

20. A device according to any one of claims 17 to 19, wherein the spring is attached to the failure element by a respective starlock washer at each end of the spring each washer being anchored to the failure element so as to be capable of movement in only one direction along the failure element.

21. A device according to any one of claims 13 to 20, wherein the failure element is made of a material which changes its appearance in the presence of the contaminant.

22. A device according to claim 13, wherein the indicator element is held in the first position by a biasing force and wherein a further force, which is strong enough to override the biasing force is arranged to act on the indicator element to move it to the second position upon failure of the failure element.

23. A device according to claim 22, wherein the failure element is a tubular element and the indicator element is within the tubular element and is fixed at one end to the failure element, while its other end projects beyond the other end of the failure element and is biased away from the other end of the failure element.

24. A device according to claim 23, wherein the failure element and indicator element are arranged to be supported vertically, wherein the further force is gravity.

25. A device according to any one of claims 13 to 24, wherein the length of the failure element in the direction in which the indicator element moves on failure is at least 3 times, preferably at least 10 times, more preferably at least 20 times, and most preferably at least 50 times its size in any other dimension.

26. A device according to any one of claims 13 to 25, wherein the failure element comprises a number of different materials arranged in series and/or in parallel.

27. An arrangement for detecting the presence of a chemical contaminant over a predetermined area, the arrangement comprising a plurality of devices according to any one of the preceding claims arranged over the area.

28. An arrangement according to claim 27, wherein the devices are arranged substantially in parallel.

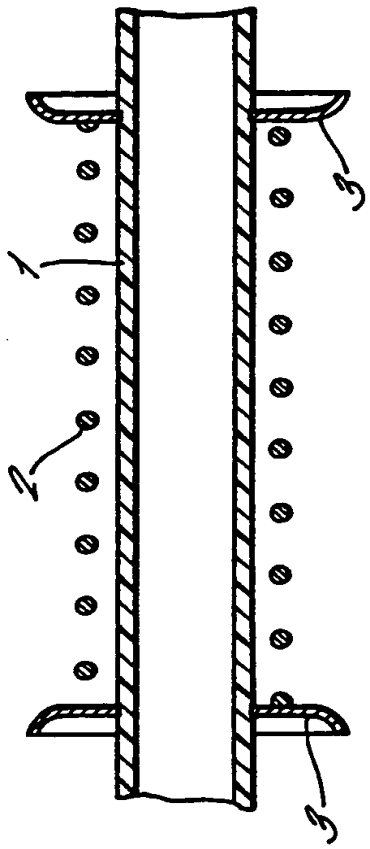


FIG.1.

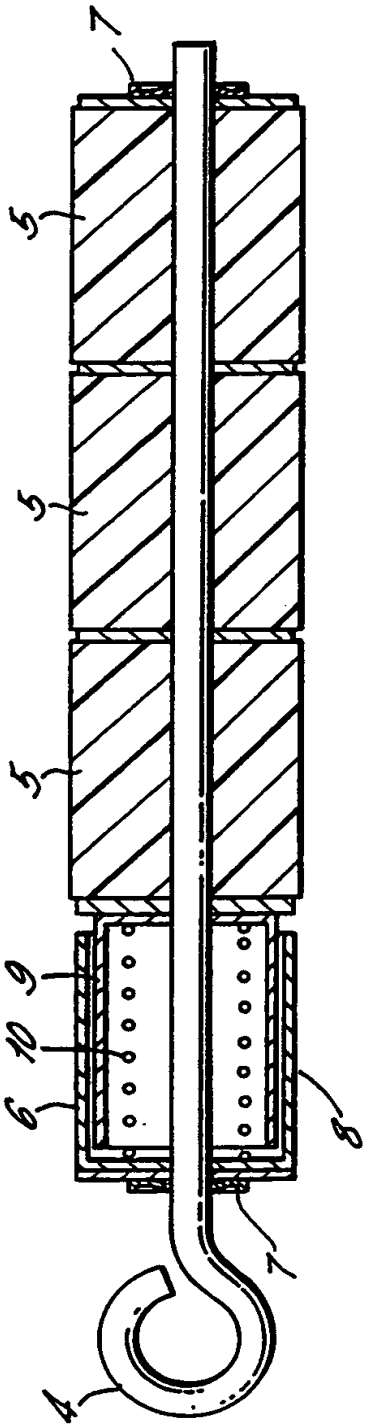


FIG.2.

FIG.3.

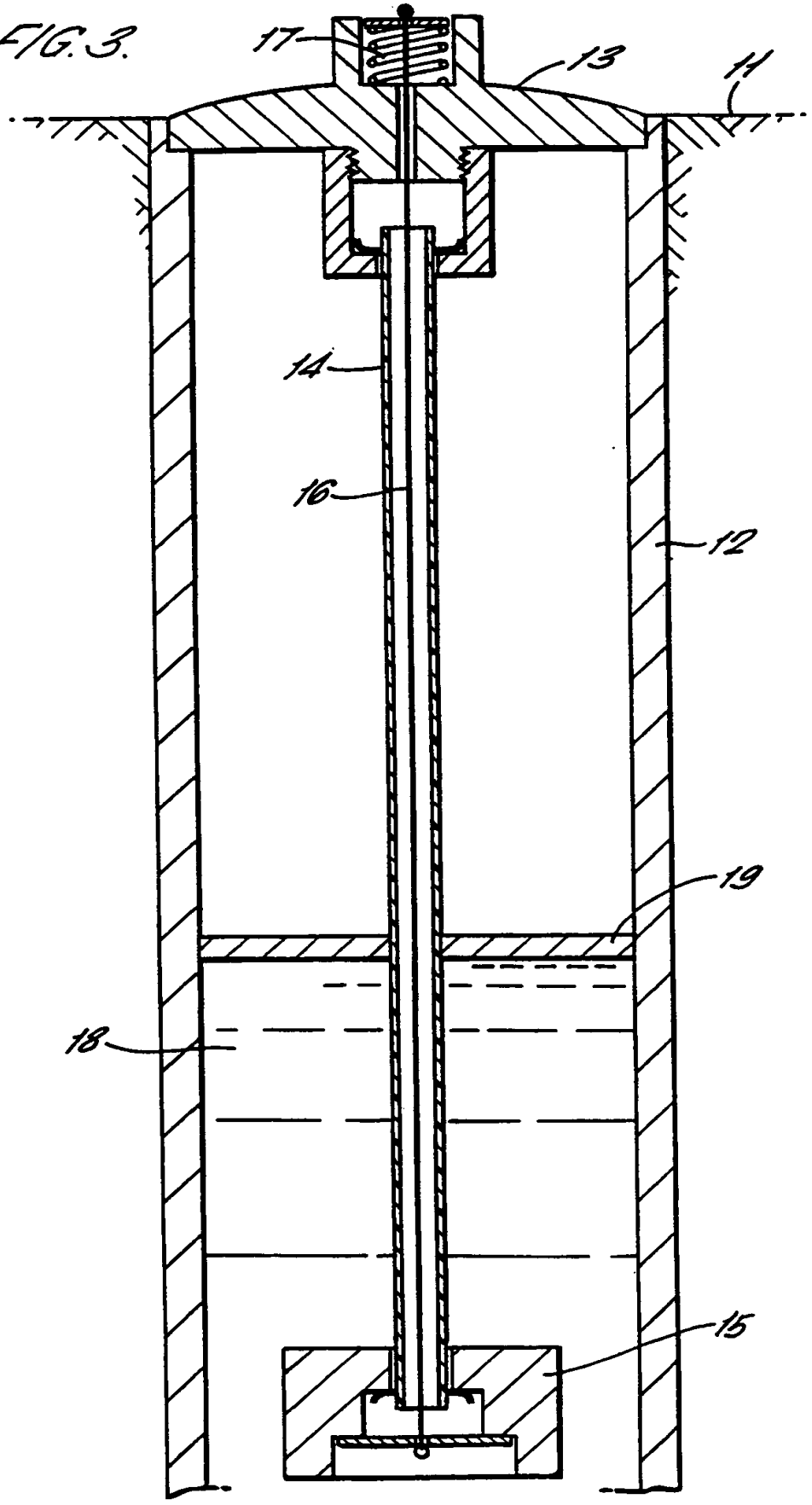
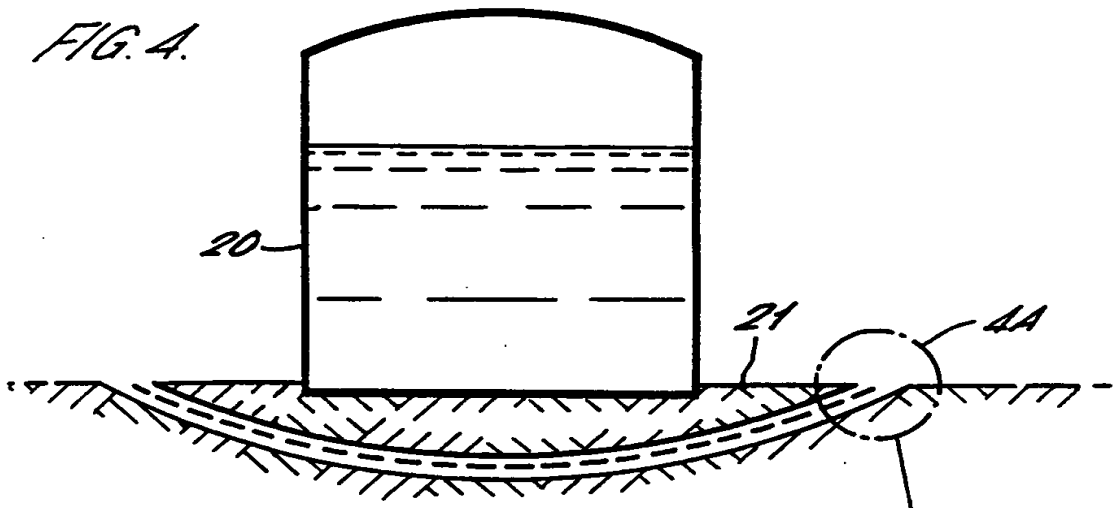


FIG. 4.



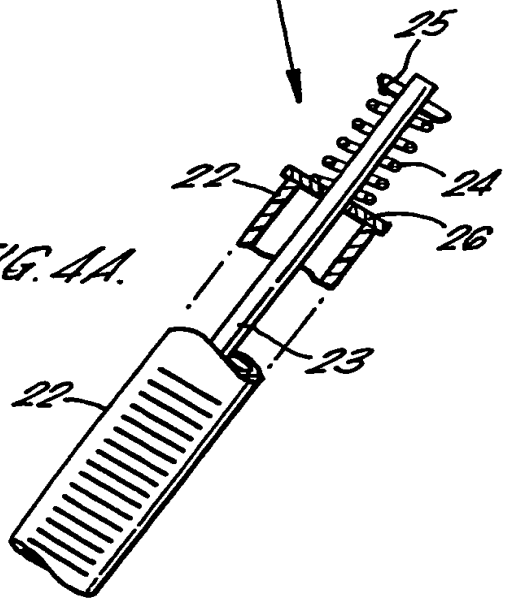
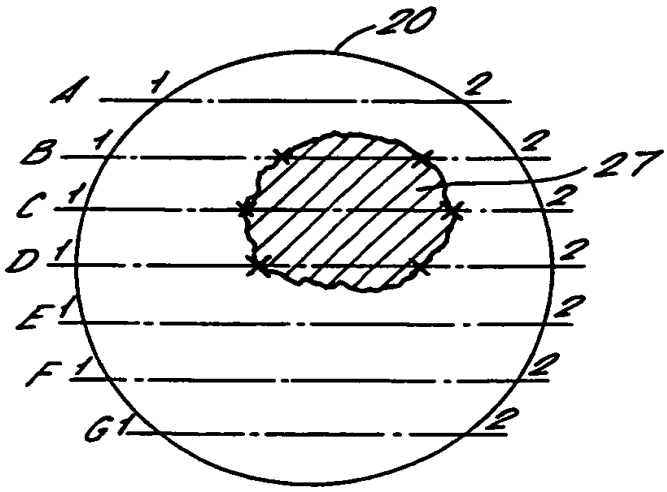


FIG. 4A.

FIG. 5.



INTERNATIONAL SEARCH REPORT

Int. ..tional Application No
PCT/GB 00/00959

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G01N17/00

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B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 846 795 A (JONES C) 5 November 1974 (1974-11-05) column 3 -column 4; figure 1	1-28
A	WO 88 01052 A (UNIV MANCHESTER) 11 February 1988 (1988-02-11) figure 1	1-28
A	US 4 628 252 A (TERHUNE JAMES H ET AL) 9 December 1986 (1986-12-09) figure 1	1-28
A	US 5 728 943 A (RIZZO FRANK E ET AL) 17 March 1998 (1998-03-17). figures 1,2	1-28

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Int. .tional Application No
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